U.S. Department of Transportation

United States Coast Guard

Commandant (G-SEC)
United States Coast Guard

2100 Second Street, S.W.
Washington, DC 20593-0001
Phone: (202) 267-1907

COMDTNOTE 16500

DEC - 6 1996

COMMANDANT NOTICE 16500

CANCELLED: DEC 5 1997

Subj: CHANGE 1 TO COMDTINST M16500.8A, AUTOMATION TECHNICAL GUIDELINES

1. PURPOSE. This notice promulgates changes to the Automation Technical Guidelines.

2. ACTION. Area and district commanders, commanders of maintenance and logistics commands and unit commanding officers shall ensure that the required page replacements are made for this change.

3. PROCEDURES.

   a. This change amends the guidance on range categories and their application criteria presented in Chapter 1, and consists of 33 replacement pages. Remove and insert the following printed pages:

Remove	Insert
i thru iv	i thru iv
1-1 thru 1-22	1-1 thru 1-29

   b. Units that have not received COMDTINST M16500.8A, but have received this Change may requisition a copy of COMDTINST M16500.8A from the DOT Warehouse in accordance with COMDTNOTE 5600; Directives, Publications and Reports Index.

E. J. BARRETT
Chief of Systems

DISTRIBUTION - SDL No. 134

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
A																										
B		8	20*		1									6	3				3			2				
C				1		2	3				1										1		1			
D				1																1						1
E							1	1														1				
F																										
G																										
H																										

NON-STANDARD DISTRIBUTION: *B:c MLCLANT & MLCPAC (6 extra)

RECORD OF CHANGES

CHANGE NUMBER	DATE OF CHANGE	DATE ENTERED	BY WHOM ENTERED

AUTOMATION TECHNICAL GUIDELINES

CONTENTS

CONTENTS (Continued)

FIGURES

CHAPTER 1. PROGRAM OVERVIEW AND PROCEDURES

A. Program Goals.

1. The goal of past lighthouse automation and future modernization programs is to reduce operations and maintenance (O&M) costs for lighthouse systems, and to diminish the opportunities for remote or hazardous duty by our people. The O&M costs are contained in transportation, personnel and maintenance equipment/materials.

2. This goal is reachable through a consistent, long-term commitment to the development and use of quality standard equipment design configurations and effective personnel training.

B. Instruction Scope.

The manual provides technical guidance for equipment selection, configuration and installation which will be most useful to engineers installing systems of considerable complexity. More guidance on the requirements for modernizing lighthouses and ranges may be found in COMDTINST M16500.3A, Aids to Navigation Manual - Technical; COMDINST M16500.4B, Range Design Manual; COMDTINST M10550.25, Electronics Engineering Manual; and COMDTINST M11000.11, Civil Engineering Manual. When guidance pertaining to lighthouse modernization in the above manuals conflicts, direction in this manual applies.

C. Program History.

1. Beginnings. The construction of the first large lighthouses in North America began in the early 1700's. Personnel at these lights, often entire families, cared for the structure and maintained signal operations. Signals were first powered by whale oil, then kerosene, and finally electricity. It is important to note that because of the age of these structures and their importance to the maritime industry, many are now considered to be historically significant properties, worthy of special consideration in their maintenance and upkeep.

2. Automation. With the development of reliable electro-mechanical switching devices and high-endurance diesel engines, removal of personnel and automatic operation became attractive in the early 1960's. Thus began an era of about 25 years during which personnel were removed from lighthouses. Though savings have been achieved as a result of decreased personnel costs, highly reliable operation was not achieved.

3. Present Situation. The bulk of lighthouse system O&M costs now go toward servicing visit transportation and

personnel costs. Our next great challenge is to gain more reliable automated operation, thus creating a diminished need for service visits. Solid-state control systems and natural energy sources will provide this greater reliability, while we continue to properly serve the mariner. The wise implementation of solid-state technology promises to significantly increase lighthouse system reliability and reduce the associated O&M costs. Because of the historical nature of many lighthouse properties, implementation of new technologies must include serious consideration for maintaining the historic nature of the properties.

D. Lighthouse Equipment Configuration Categories.

1. Purpose. Categories help the engineering support manager and the district program manager to discern which equipment configuration will meet the operational needs of the aid to navigation site. The various categories are designed to meet various and distinct levels of operational need. Figure 1-1 merges the operational requirement and engineering support issues into one decision flow diagram. Generally speaking, higher levels of operational need require more signal range (power), higher signal availability (equipment redundancy), and shorter time to restore the signal or advise the mariner of an outage (monitoring).

2. Rationale. Standard equipment configurations encourage better engineering design and operational need decision-making by district program managers. Standardization also allows for economies in personnel training and equipment procurement, and it promotes the effectiveness of maintenance personnel.

3. Configurations. Installation, interconnection, and troubleshooting drawings for these equipment configuration categories are available from Commandant (G-SEC-2) in AUTOCAD format. Chapter 7 discusses installation requirements. All standard equipment is described in COMDTINST M16500.3A.

a. Category I Equipment Configuration. Normally, lights in this category were manned and are a critically important aid to navigation, thus justifying the very substantial cost of installation, operation and maintenance. This equipment suite provides a high intensity light and sound signal and may have a RACON. Emergency signals and power systems, and remote electronic monitoring make this the most complex equipment suite. (Figure 1-2).

b. Category II Equipment Configuration. Like Category I, lights in this category were once manned. This equipment suite resembles the Category I suite except that the power equipment is considerably less involved since there is no standby engine-generator. It is intended for sites where commercial electrical power is reliable. (Figure 1-3).

c. Category III Equipment Configuration. This category provides the capability for emergency signals like those above, but without remote electronic monitoring capability. (Figure 1-4).

d. Category IV and V Equipment Configurations. Use these equipment configurations where commercial electrical power is reliable and emergency signals are not required. (Figure 1-5 and 1-6).

e. Category VI Equipment Configuration. Consists of a primary battery and light.

f. Solar Category I Equipment Configuration. Often, lights in this category were once manned and are a critically important aid to navigation, but may now have a diminished signal range requirement. This equipment suite can provide a seacoast light with a nominal range of up to 22 nautical miles, a 2-mile sound signal, and a RACON. Variables of latitude, cloudiness, solar panel area and battery capacity all constrain these system capabilities in some sites. Emergency signals and remote electronic monitoring make this the most complex solar-powered equipment suite. (Figure 1-7).

g. Solar Category II Equipment Configuration. This equipment suite resembles the Category I solar-powered aid to navigation except that it does not have remote electronic monitoring capability. (Figure 1-8).

h. Solar Category III Equipment Configuration. This equipment suite resembles the Category VI aid to navigation, but is solar-powered rather than primary-battery powered. It has no emergency signals, no electronic monitoring, nor any reserve battery capacity. (Figure 1-9).

E. Range Equipment Configuration Categories.

1. General. As increasingly capable range systems become more common, standardizing their signal equipment systems becomes increasingly beneficial. Figure 1-10, Range Category Selection Aid, merges the operational requirement and engineering support issues into one

decision flow diagram, to help the engineering support manager and the district program manager make the right selection for a specific range.

2. Configurations. Front and rear signals can be powered independently of each other. Either may be solar or commercial powered, and their function as a range will remain unchanged. Installation, interconnection, and troubleshooting drawings for these equipment configuration categories are available from Commandant (G-SEC-2) in AUTOCAD format. Chapter 7 discusses installation requirements. All standard equipment is described in COMDTINST M16500.3A. Range signal design is described in COMDTINST M16500.4B.

   a. Commercial Night (Only) Range (Range Category C-N) Equipment Configuration. This category provides a 120 VAC powered signal or 12V signal with A/N power supply for nighttime operation. (Figure 1-11).

   b. Commercial 24 Hour Range (Range Category C-24) Equipment Configuration. This category provides a 120 VAC powered signal for 24 hour operation. (Figure 1-12).

   c. Commercial Day/Night Range (Range Category C-D/N) Equipment Configuration. This 120VAC powered equipment suite provides a high intensity daytime light signal and a less intense nighttime signal. Switching between day and night signals is controlled by the light-sensitive Range Switch Box (RSB-AC). (Figure 1-13).

   d. Commercial Day/Night Range - Synch Transfer (Range Category C-RLC) Equipment Configuration. This 120VAC powered equipment suite provides a high intensity daytime signal, a much less intense nighttime signal, and an optional emergency signal. Because the day and night signal intensities are so different, switching between day and night signals is synchronized by Range Light Controllers (RLC) on both front and rear platforms; this extra level of control is necessary because the Range would otherwise be unusable during those short periods morning and night when the front and rear signal lights would not be in the same day or night mode. (Figure 1-14).

   e. Solar Night (Only) Range (Range Category S-N) Equipment Configuration. This category provides a 12V solar-powered signal for nighttime operation. (Figure 1-15).

   f. Solar 24 Hour Range (Range Category S-24) Equipment Configuration. This category provides a 12V solar-powered signal for 24 hour operation. (Figure 1-16).

g. Solar Day/Night Range (Range Category S-D/N) Equipment Configuration. This 12VDC powered equipment suite provides a high intensity daytime light signal and a less intense nighttime signal. Switching between day and night signals is controlled by the daylight controlled Range Switch Box (RSB-DC). Variables of latitute, cloudiness, solar panel area and battery capacity all constrain the system capabilities in some sites. (Figure 1-17).

h. Solar Day/Night Range - Synch Transfer (Range Category S-RLC) Equipment Configuration. This 12VDC powered equipment suite provides a high intensity daytime signal, a much less intense nighttime signal, and an optional emergency signal. Because the day and night signal intensities are so different, switching between day and night signals is synchronized by Range Light Controllers (RLC) on both the front and rear platforms; this extra level of control is necessary because the Range would otherwise be unusable during those short periods morning and night when the front and rear signal lights would not be in the same day or night mode. Variables of lattitude, cloudiness, solar panel area and battery capacity all constrain the system capabilities at some sites. (Figure 1-18).

i. Optional Emergency Range Signals. These 12VDC solar powered emergency signals provide an optional emergency signal when the A/N program manager determines that local conditions warrant; the emergency signal is controlled off by a voltage sensing relay on the main signal power feeder; if main power fails, the emergency light is activated; when main power is restored, the emergency light is turned off, and the battery is recharged by the emergency solar panel. (Figure 1-19).

F. Program Planning.

1. Waterways Analysis Management system (WAMS) Studies. Output from WAMS evaluations may be the most significant tool for specifically identifying which lighthouse or range system category adequately meets the operational need. WAMS evaluations identify waterway criticality and requirements for ATON systems.

2. Backlog Development. Accurate forecasts of program and standard equipment needs are maintained through Civil Engineering Unit (CEU) and District (oan) project lists or backlogs. These forecasted needs are normally communicated upward by a District Aids to Navigation Operations Request (CG-3213) as a result of a WAMS

evaluation, a Shore Station Maintenance Request (SSMR) submission resulting from a biennial civil engineering inspection, or in response to the annual project and equipment planning survey conducted by the Commandant (G-SEC).

3. Project Execution. Engineering support for lighthouse and range systems must be incorporated into the entire engineering support function. We recommend use of experienced Coast Guard in-house engineering talent and industrial capacity. In view of the work's substantially unique character, experience has shown that Architect/ Engineering (A/E) firm and contractor learning curves are often unprofitably long. This will probably become evident in attempts to obtain quality A/E firm designs for lighthouse modernization at a price below the six percent A/E design fee limitation; however, A/E design of modern range structures has proven successful.

4. Engineering Support Units. Maintenance & Logistics Commands (MLC) will need to effectively merge the engineering and design capacity in the Civil Engineering Units (CEU) and MLC Electronic Systems Branches [MLC(te)] with the support demand from district program managers and the area funds available to execute projects.

G. Project Submission.

1. Required Documentation. Lighthouse and range modernization projects require submission of a project package for headquarters review. The package will consist of an Aids to Navigation Operation Request (CG-3213/3213A), Project Development Submittal (PDS) and ELECTRONALT. Normally, packages should be submitted to headquarters before 1 August each year for subsequent year execution. See Figure 1-20 for the project documentation approval process.

2. Approval Process. CEU's should request the CG-3213/3213A documentation from District (oan), the ELECTRONALT from the MLC(te), and taking account of environmental and historic preservation requirements, develop the PDS. The CEU shall send the consolidated packages to Commandant (G-OPN) who will conceptually approve the project. After conceptual approval, Commandant (G-SEC) will do a technical review and schedule shipment of standard equipment for lighthouse installation. Commandant (G-SCE) will approve and sign the ELECTRONALT. Final approval of the project will be indicated by a Commandant (G-OPN) endorsement of the CG-3213. This endorsement will address equipment availability and will enclose the ELECTRONALT and the Commandant (G-SEC) approved PDS, with any exceptions noted. Headquarters equipment will be provided upon request (to Commandant (G-SEC) via E-mail

or letter) for specific projects after those projects are submitted, approved, and ready for execution. OE-funded lighthouse modernizations are usually executed in the year after project approval. Approved Waterways AC&I-funded projects, typically for new construction of significant range structures, are added to the Waterways AC&I project backlog. When they are within a year of funding, they then enter the CEU design phase in preparation for execution in the following year. Any significant project changes such as scope, cost, structure location, or operational range design, should be resubmitted for approval prior to A/E contract award, or as soon as revealed thereafter.

The following guidance on project documentation applies:

Project Scope	Documentation Required
Any ATON signal or category change	CG-3213 and CG 3213A
Any HQ-Furnished Equipment Category III, Solar II,	Same as above plus PDS
Any Range Tower Construction	Same as above plus Range Design
Category I and II, Solar Cat. I, Range Category C-RLC and S-RLC	Same as above plus ELECTRONALT

3. Aids to Navigation Operation Request (CG-3213 and CG-3213A). The CG-3213 and CG-3213A shall give a clear indication of existing ATON equipment to remain and new equipment to be installed. The environmental impact of sound signals must be addressed in the CG-3213. Also, any historic property and classical lens disposition issues must be addressed.

4. Project Development Submittal (PDS). The PDS shall describe the scope of work, cost, and standard equipment needed to modernize or solarize a lighthouse or range system. Its purpose is to ensure that the project conforms to the standard aid configurations and Commandant policy in areas such as environmental compliance and historic preservation.

   The PDS cover letter should contain the following items:

   a. Operational requirement;
   b. Cost estimate;
   c. Site plan;
   d. Description of the standard system configuration to be employed and standard equipment needed;
   e. Floor plan including layout of standard equipment; and

f. Description of project solutions to satisfy environmental and/or historicity problems.

5. Range Design. The range design shall address tower heights and locations, dayboard vs daytime light signals, single or dual intensity lights, and passing lights if needed. See COMDTINST M16500.4B, Range Design Manual for guidelines for Range Design and specific advice on using the latest Range Design Program.

6. ELECTRONALT. The ELECTRONALT shall outline any planned changes to radio aid or electronic monitor and control equipment at the light, in detail. If a new radio link is required (for LEACMS or Range Light Controller (RLC)), frequency authorization shall be requested in accordance with COMDTINST M2000.3., Telecommunications Manual.

CATEGORY SELECTION AID

CATEGORY DEFINITIONS

I. MONITORED AND CONTROLLED, AC-LINE OR ENGINE/GENERATOR SYSTEM WITH ENGINE/GENERATOR BACKUP AND 12VDC EMERGENCY SIGNALS.

II. MONITORED AND CONTROLLED, AC-LINE SYSTEM AND 12VDC-EMERGENCY SIGNALS.

III. AC-LINE AND 12VDC EMERGENCY SIGNALS.

IV. AC-LINE SYSTEM WITHOUT EMERGENCY SIGNALS.

V. AC-RECTIFIED AND STEPPED DOWN 12VDC SYSTEM.

VI. BATTERY POWERED 12VDC SYSTEM.

VII. DAYMARK ONLY.

SOLAR I. REMOTELY MONITORED AND CONTROLLED, 12VDC SOLAR POWERED SYSTEM WITH EMERGENCY SIGNALS.

SOLAR II. UNMONITORED, 12VDC SOLAR POWERED SYSTEM WITH EMERGENCY SIGNALS OPTIONAL.

SOLAR III. UNMONITORED, 12VDC SOLAR POWERED SYSTEM WITHOUT EMERGENCY SIGNALS.

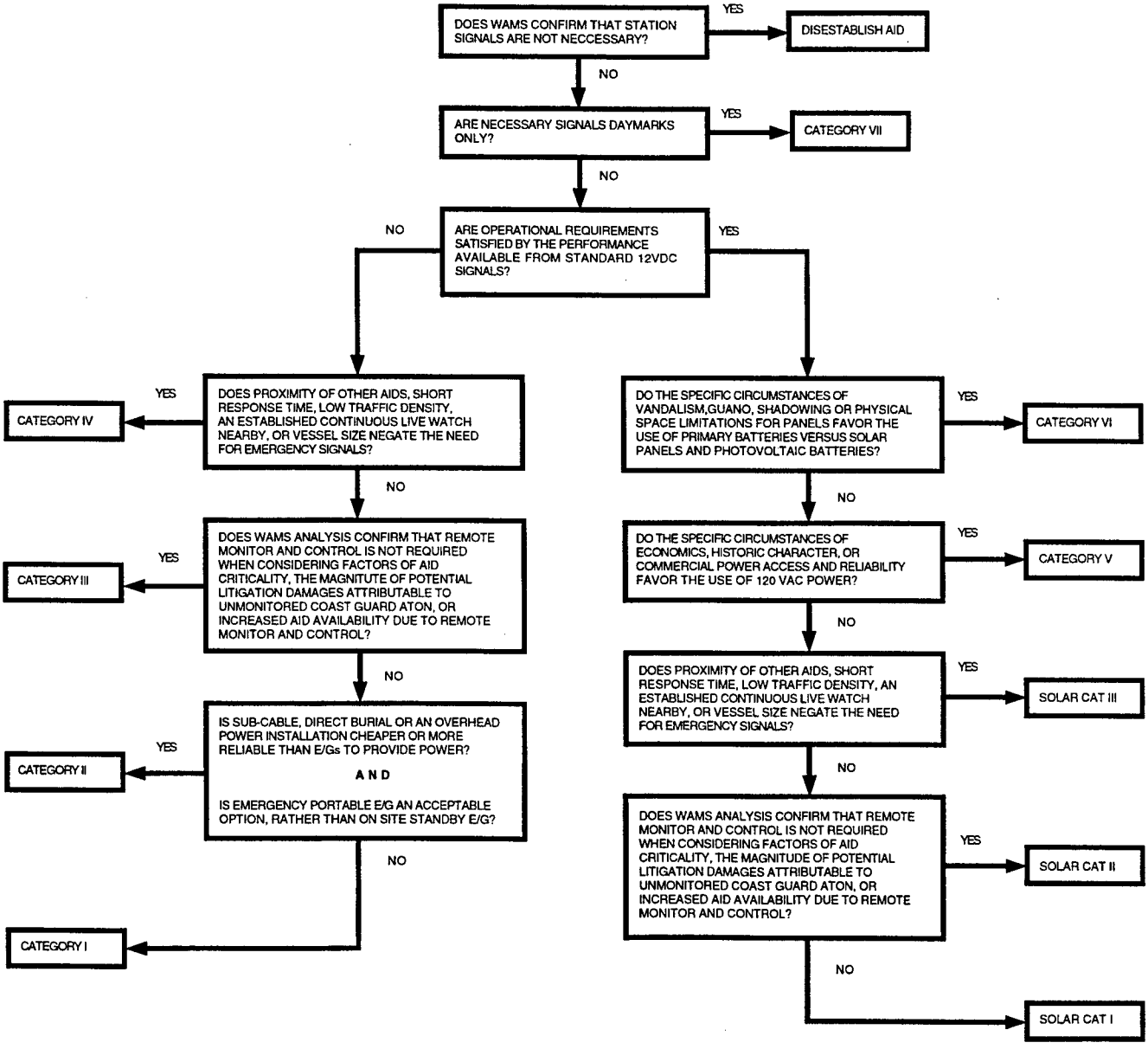
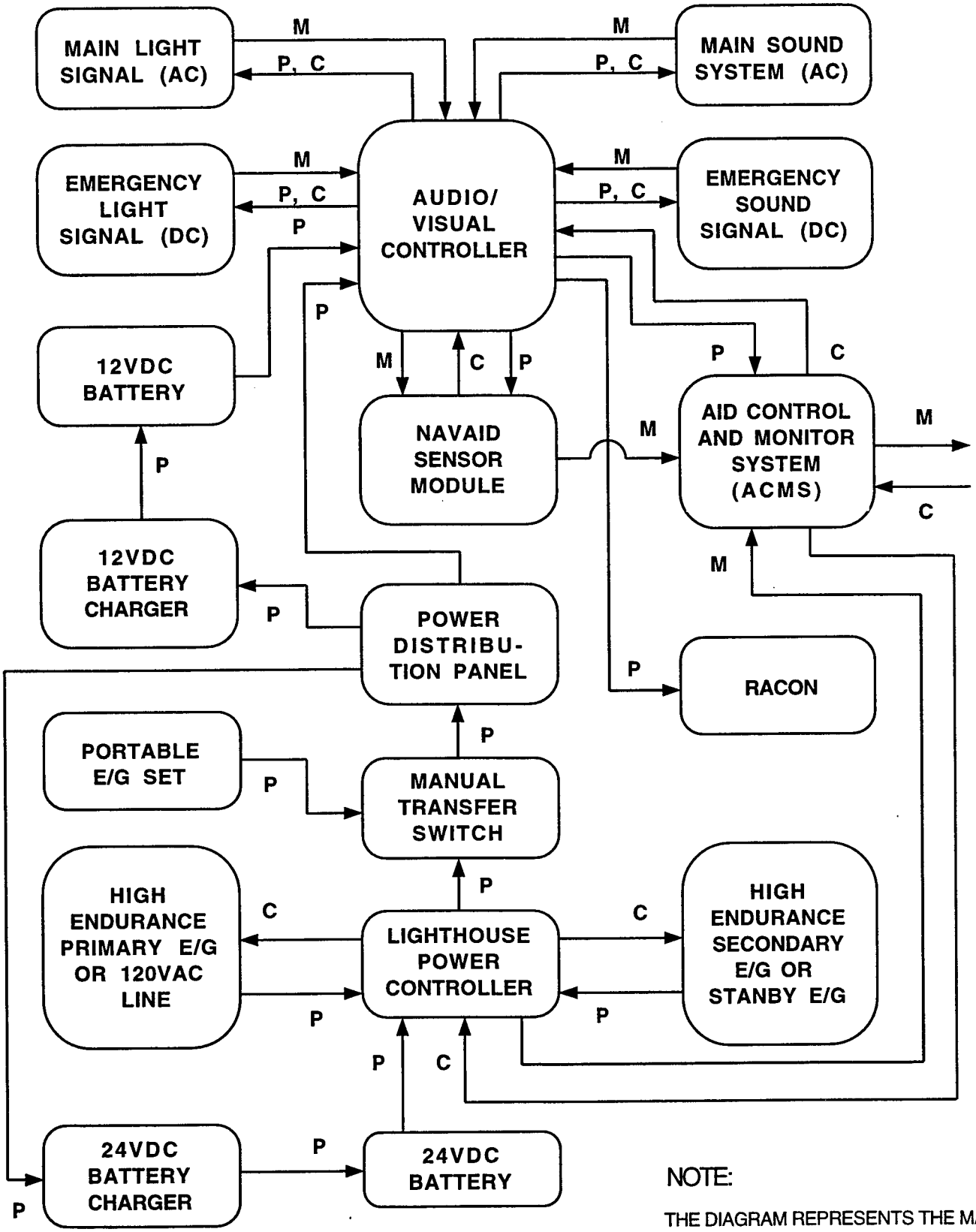


FIGURE 1-1

CATEGORY I

FOG DETECTOR &/OR ACMS CONTROL OF SOUND SIGNAL IS OPTIONAL
SYMBOLS: M = MONITOR, P = POWER, C = CONTROL



NOTE:

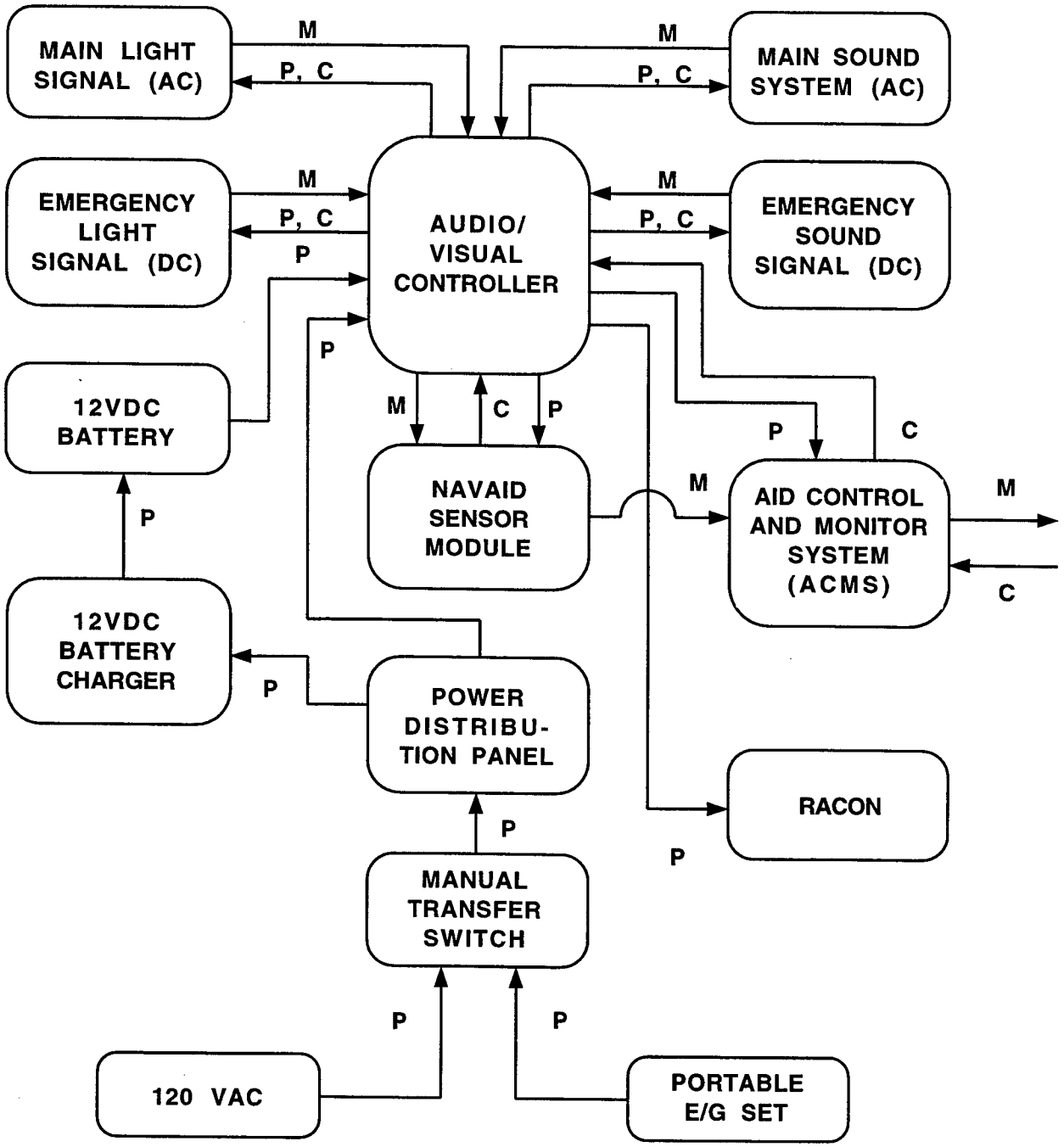
THE DIAGRAM REPRESENTS THE MAX ARRAY OF SIGNAL EQUIPMENT. THE ACTUAL ARRAY SHOULD BE CHOSEN TO MEET OPERATIONAL NEEDS.

FIGURE 1-2

CATEGORY II

FOG DETECTOR &/OR ACMS CONTROL OF SOUND SIGNAL IS OPTIONAL

SYMBOLS: M = MONITOR, P = POWER, C = CONTROL



NOTE:

THE DIAGRAM REPRESENTS THE MAX ARRAY OF SIGNAL EQUIPMENT. THE ACTUAL ARRAY SHOULD BE CHOSEN TO MEET OPERATIONAL NEEDS.

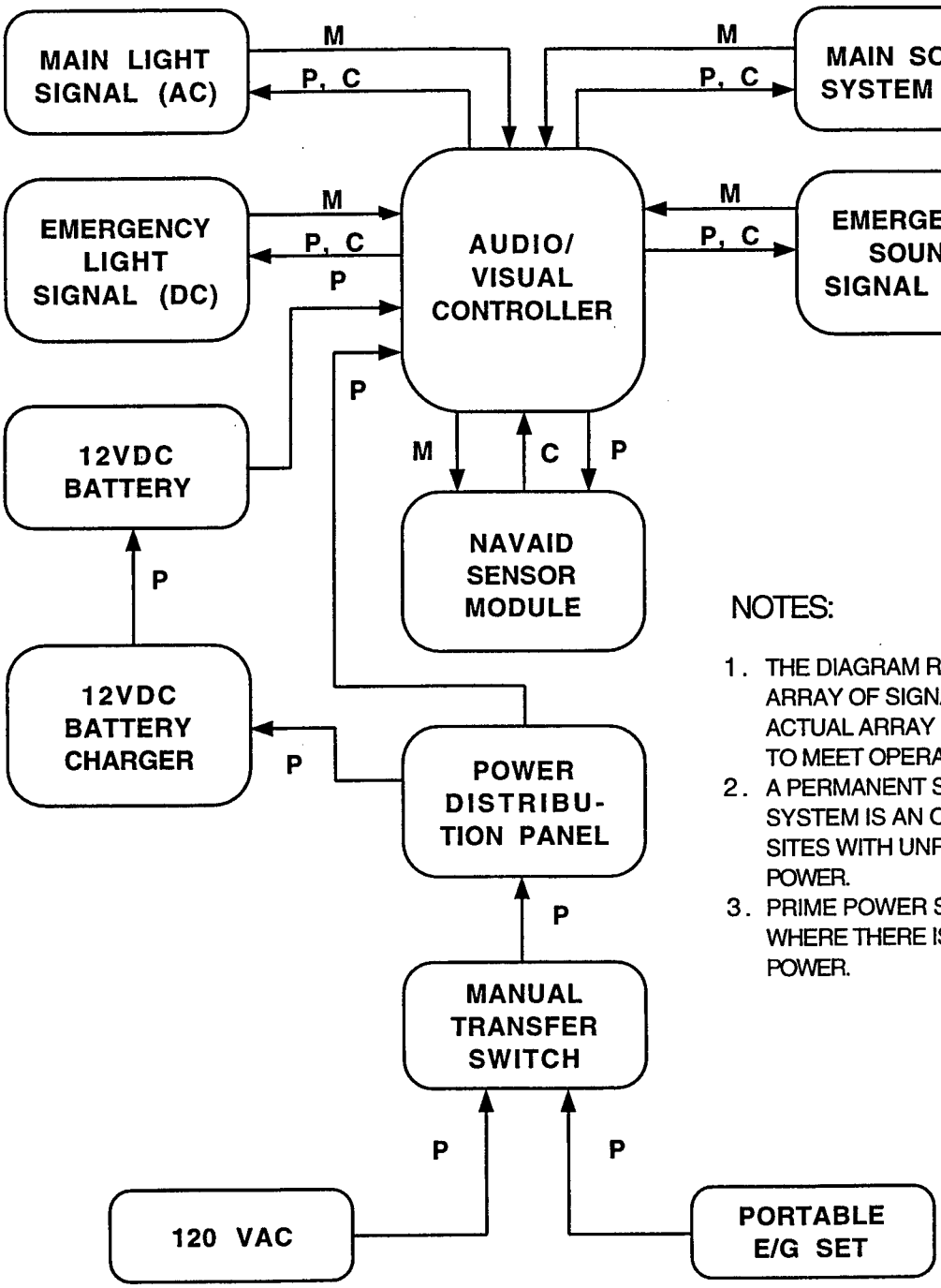
FIGURE 1-3

CATEGORY III

OPTIONS:

DAYLIGHT CONTROL OF MAIN LIGHT SIGNAL;
FOG DETECTOR CONTROL OF SOUND SIGNAL

SYMBOLS: M = MONITOR, P = POWER, C = CONTROL



NOTES:

1. THE DIAGRAM REPRESENTS THE MAX ARRAY OF SIGNAL EQUIPMENT. THE ACTUAL ARRAY SHOULD BE CHOSEN TO MEET OPERATIONAL NEEDS.
2. A PERMANENT STANDBY POWER SYSTEM IS AN OPTION FOR INDIVIDUAL SITES WITH UNRELIABLE COMMERCIAL POWER.
3. PRIME POWER SYSTEM IS AN OPTION WHERE THERE IS NO COMMERCIAL POWER.

FIGURE 1-4

CATEGORY IV

OPTIONS:

A. DAYLIGHT CONTROL OF MAIN LIGHT
B. FOG DETECTOR CONTROL OF SOUND SIGNAL

SYMBOLS: P = POWER, C = CONTROL

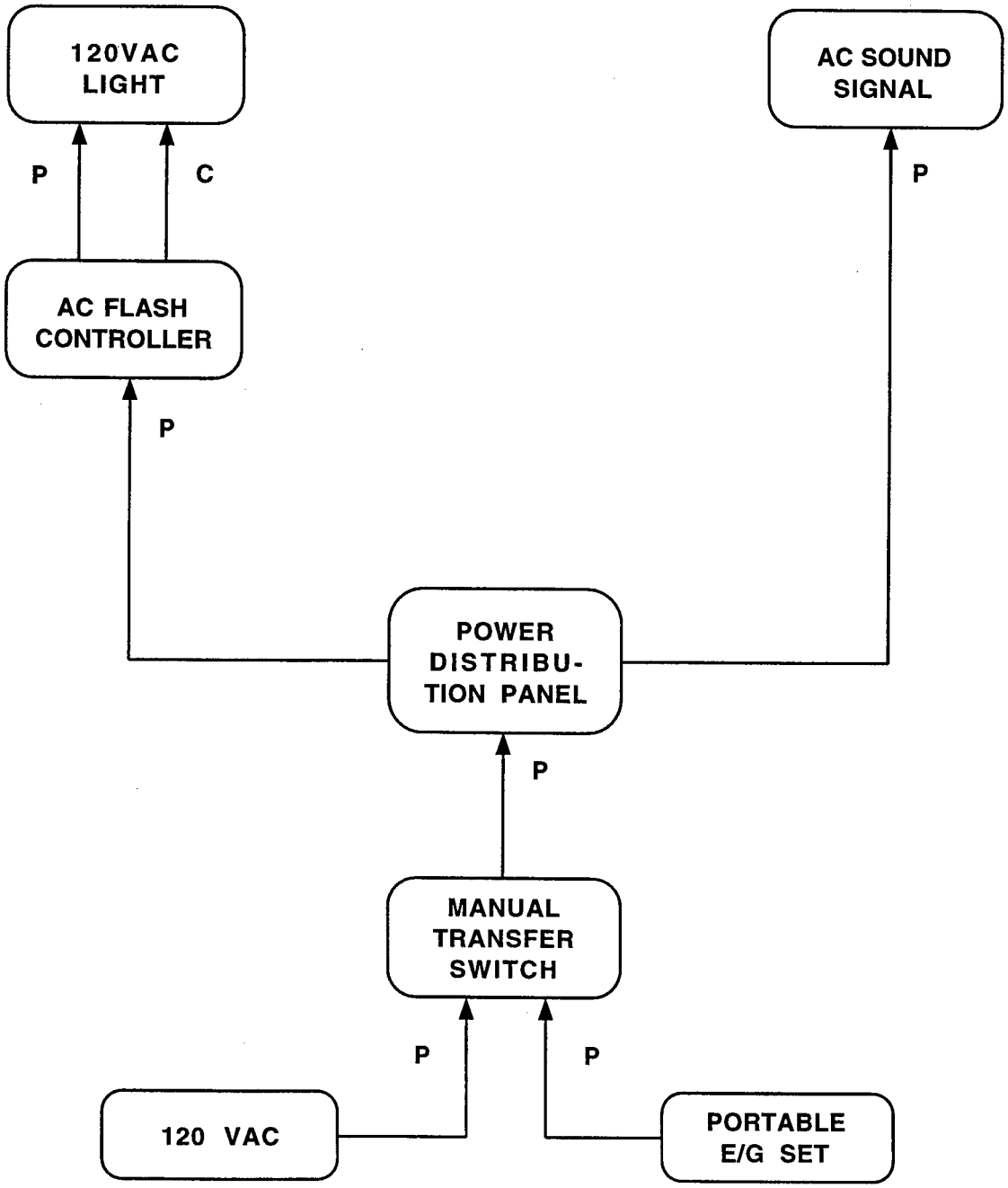
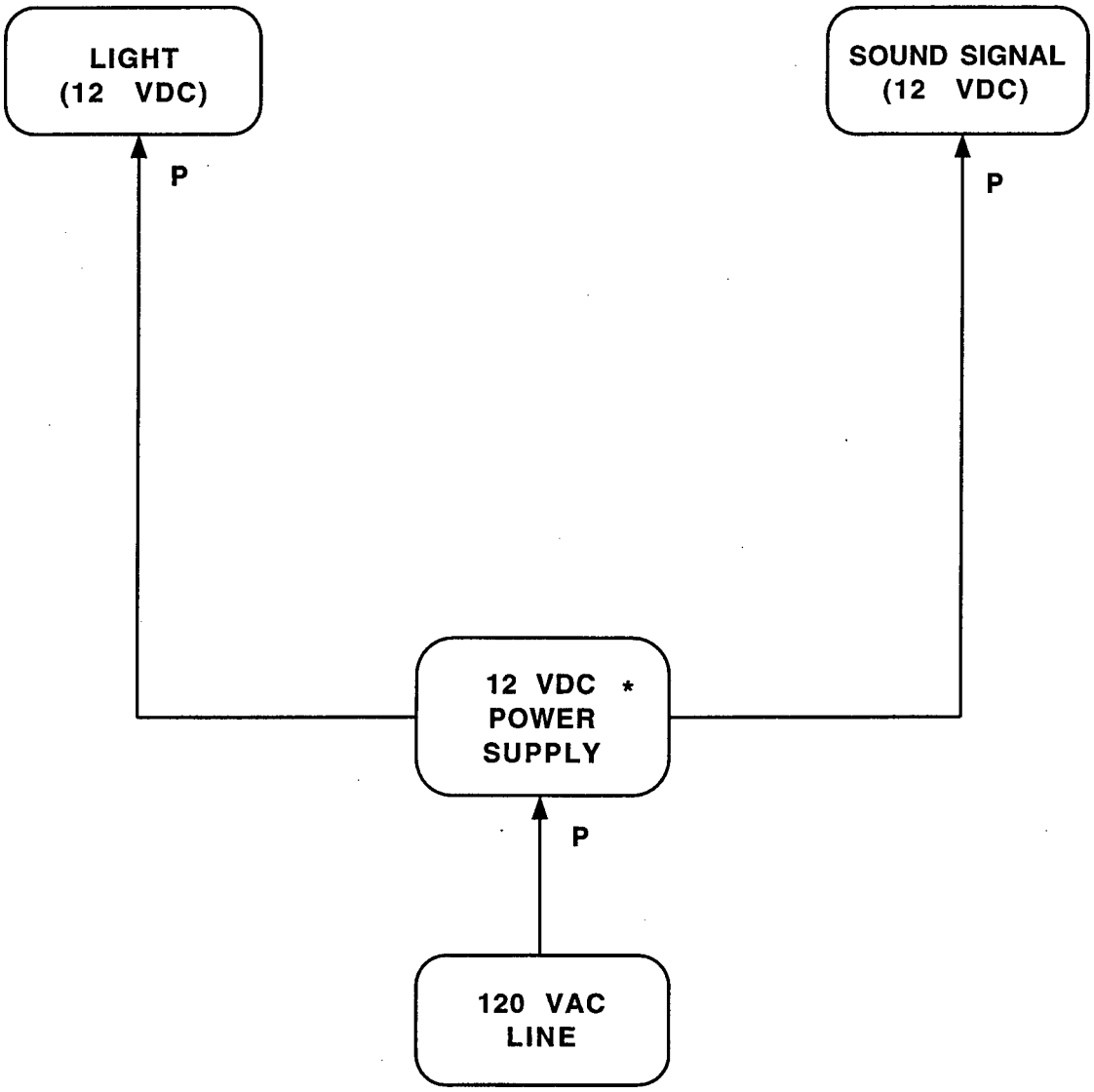


FIGURE 1-5

CATEGORY V

120VAC-RECTIFIED AND STEPPED DOWN 12VDC OR
OPTIONAL BATTERY CHARGER AND SECONDARY BATTERY

SYMBOLS: P = POWER



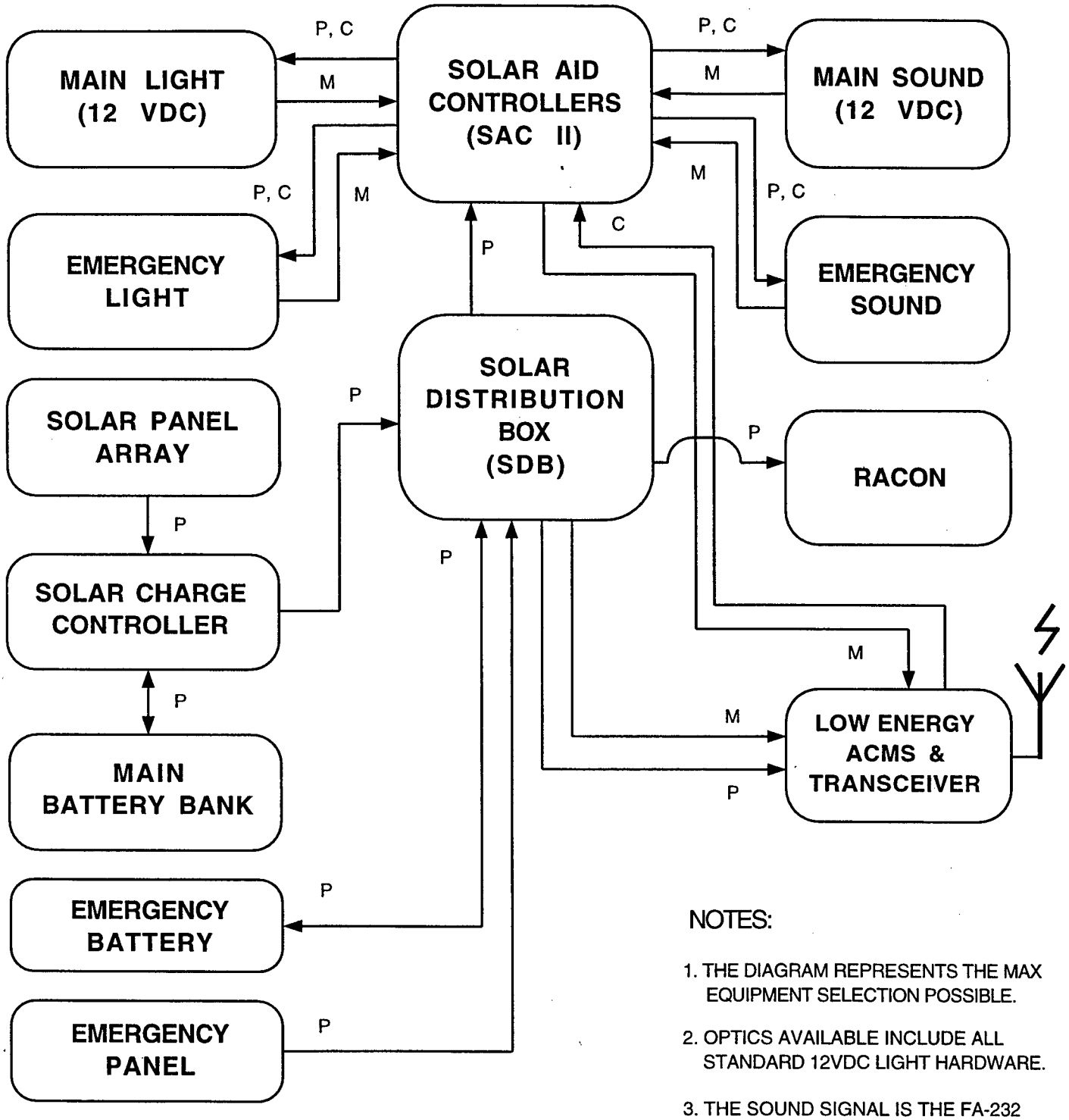
* NOTE:

OPTIONAL USE OF 12 VDC
SECONDARY BATTERY
AND CHARGER

FIGURE 1-6

SOLAR CATEGORY I

SOLAR POWERED, MONITORED AND CONTROLLED, WITH RACON,
EMERGENCY SIGNALS, AND SOLAR DISTRIBUTION BOX (SDB)



NOTES:

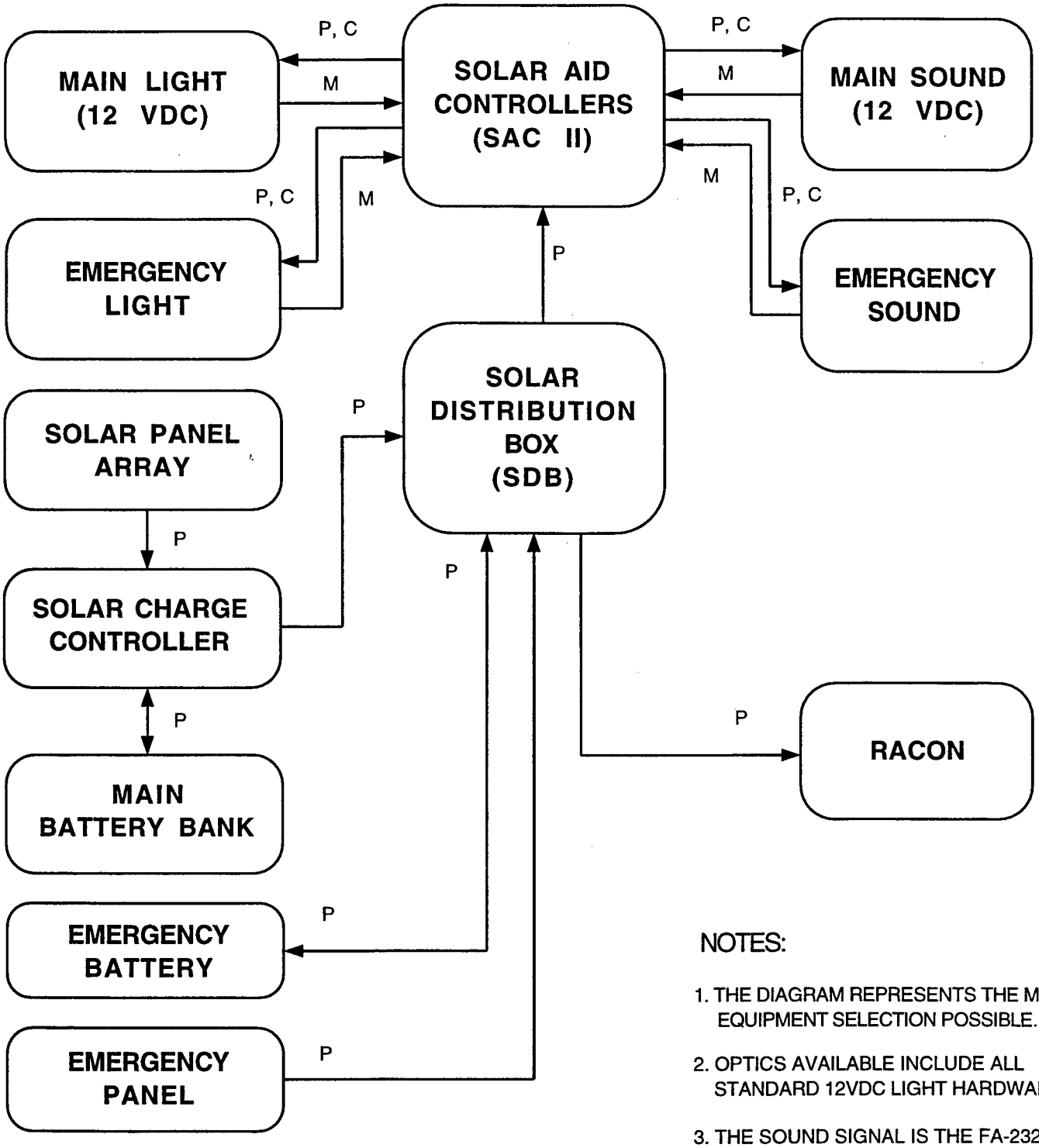
1. THE DIAGRAM REPRESENTS THE MAX EQUIPMENT SELECTION POSSIBLE.
2. OPTICS AVAILABLE INCLUDE ALL STANDARD 12VDC LIGHT HARDWARE.
3. THE SOUND SIGNAL IS THE FA-232 TYPE.

SYMBOLS: M = MONITOR
P = POWER
C = CONTROL

FIGURE 1-7

SOLAR CATEGORY II

SOLAR POWERED, WITH EMERGENCY SIGNALS, OPTIONAL RACON, AND SOLAR DISTRIBUTION BOX (SDB)



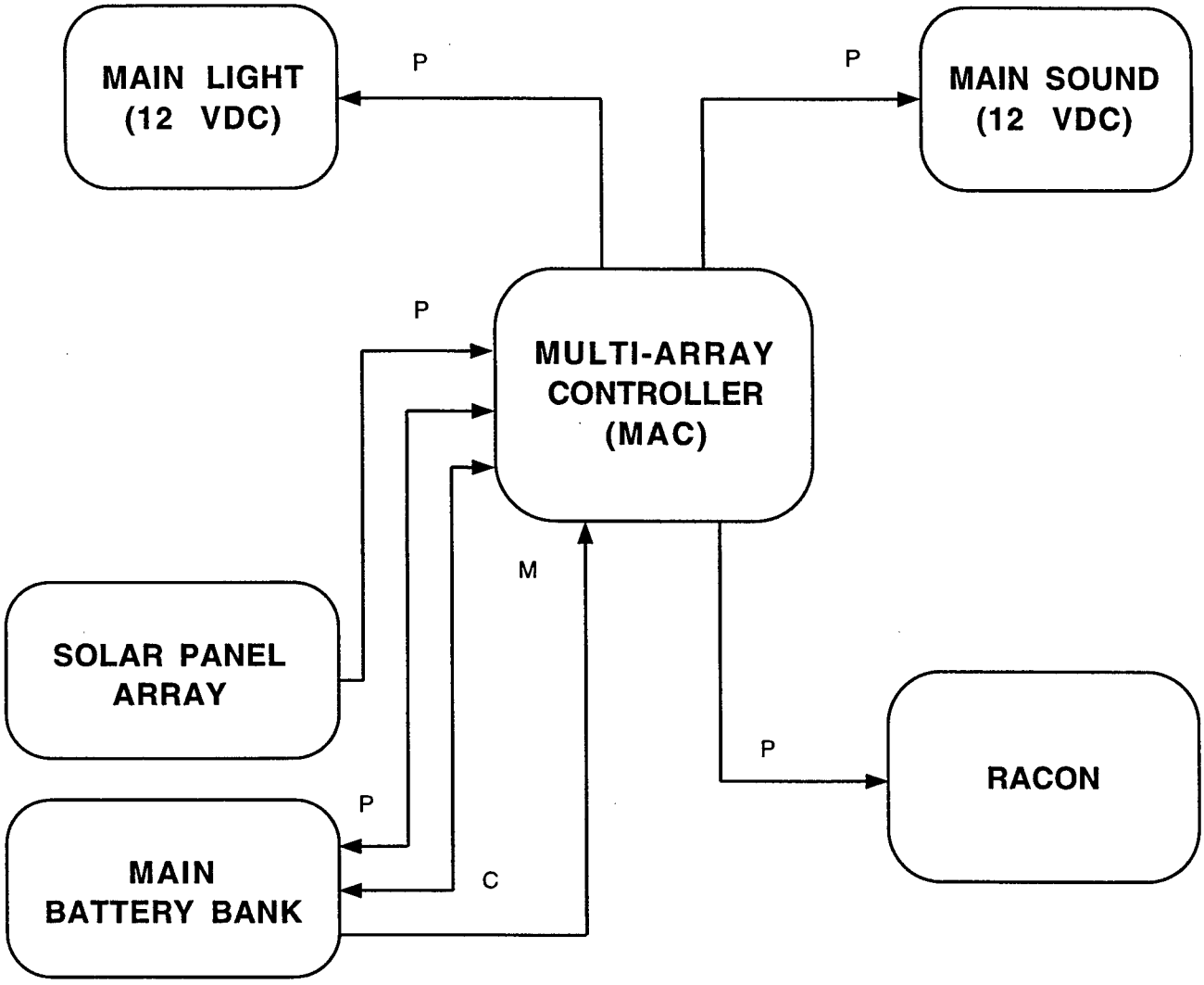
NOTES:

1. THE DIAGRAM REPRESENTS THE MAX EQUIPMENT SELECTION POSSIBLE.
2. OPTICS AVAILABLE INCLUDE ALL STANDARD 12VDC LIGHT HARDWARE.
3. THE SOUND SIGNAL IS THE FA-232 TYPE.

FIGURE 1-8

SOLAR CATEGORY III

SOLAR POWERED, WITH OPTIONAL RACON



SYMBOLS: M = MONITOR
P = POWER
C = CONTROL

NOTES:

1. THE DIAGRAM REPRESENTS THE MAX EQUIPMENT SELECTION POSSIBLE.
2. OPTICS AVAILABLE INCLUDE ALL STANDARD 12VDC LIGHT HARDWARE.
3. THE SOUND SIGNAL IS THE FA-232 TYPE.

FIGURE 1-9

RANGE CATEGORY SELECTION AID

Commercial Powered Range Category

C - N	Com'l Night (only) Lt
C - 24	Com'l 24 Hour Light
C - D/N	Com'l Day & Night Lts
C - RLC	Com'l Day & Night Lts (Synch RRL & RFL Transfer)

Solar Powered Range Category

S - N	Solar Night (only) Lt
S - 24	Solar 24 Hour Light
S - D/N	Solar Day & Night Lts
S - RLC	Solar Day & Night Lts (Synch RRL & RFL Transfer)

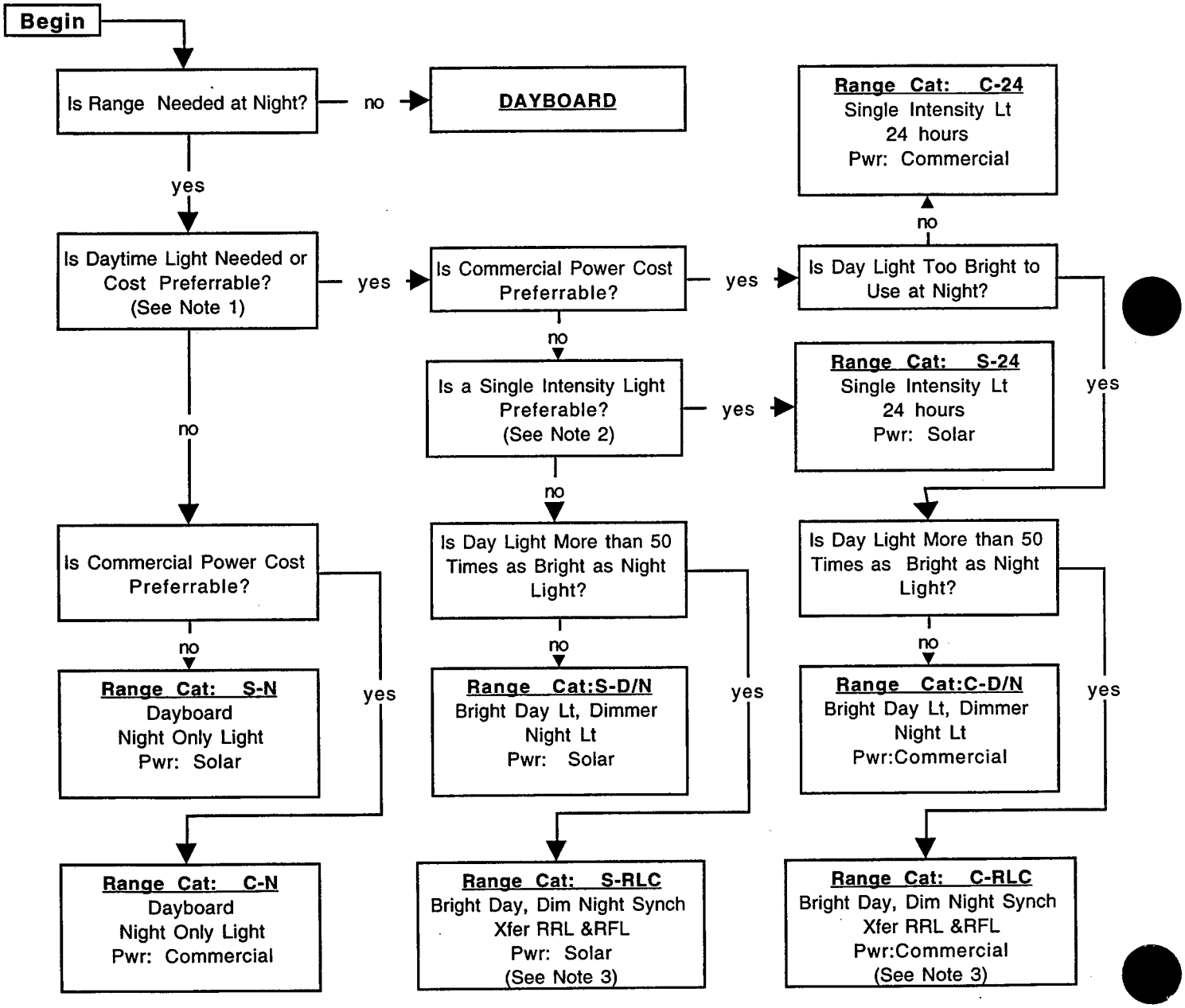


FIGURE 1-10

USCG RANGE EQUIPMENT CATEGORY CONFIGURATIONS

Commercial Powered Range Category		Solar Powered Range Category	
C – N	Comm'l Night (only) Lt	**S – N**	Solar Night (only) Lt
C – 24	Comm'l 24 Hour Light	**S – 24**	Solar 24 Hour Light
C – D/N	Comm'l Day & Night Lts	**S – D/N**	Solar Day & Night Lts
C – RLC	Comm'l Day & Night Lts (Synch RRL & RFL Transfer)	**S – RLC**	Solar Day & Night Lts (Synch RRL & RFL Transfer)

Notes to Accompany Category Selection Aid Flow Diagram

1. See COMDTINST 16500.23, Range Design Considerations, for factors to consider when deciding whether or not to use daytime lights. Using newly distributed Excel Range Design Program, design the range using dayboards, then redesign the range using daytime lights. Compare performance characteristics and associated costs of each approach to make a final judgement.

2. Like most aspects of range design, choosing between a single intensity, 24–hour signal or a dual intensity, day/night signal for solar applications involves trade–offs:

a. Factors that favor a single intensity light include:
- Fewer Optics (to buy and service)
- No need for day/night control switching
- Brighter night light usually a superior signal
- Simpler system

b. Factors that favor a bright day light and a dimmer night light:
- Requires fewer solar panels than brighter 24–hour light
- Requires less battery capacity than brighter 24–hour light
- Dimmer night light will tend to lower required height of Rear Range Light

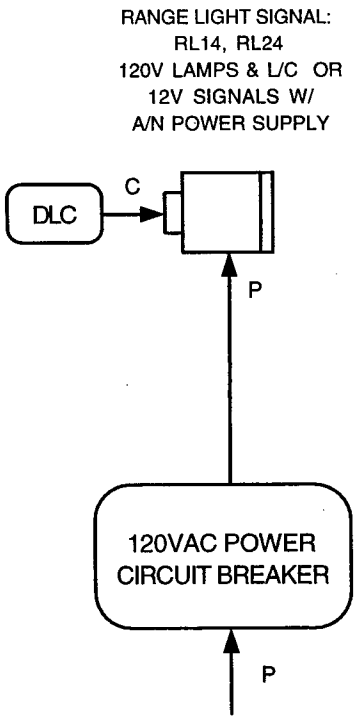
3. The Range Light Controller (RLC) is an EECEN–developed, microprocessor–based device to synchronize switching of front and rear lights from day to night signals simultaneously; its use is recommended when day and night light intensities differ by so much that the range is **not usable** in the short period when both front and rear lights are not in the same day or night mode.

COMMERCIAL-NIGHT (ONLY) RANGE (Category C-N)

OPTIONAL EMERGENCY LIGHT

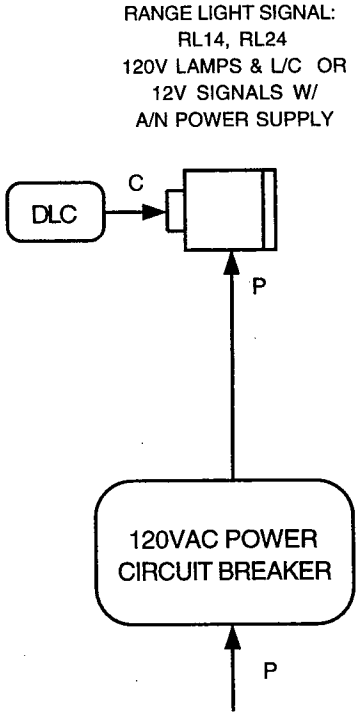
NOTE:

FRONT AND REAR SIGNALS ARE INDEPENDENT OF EACH OTHER. EITHER MAY BE SOLAR OR COMMERCIAL POWERED; FUNCTION WILL REMAIN UNCHANGED.



REAR RANGE STRUCTURE

SYMBOLS: C = CONTROL
P = POWER
DLC = DAYLIGHT CONTROL



FRONT RANGE STRUCTURE

FIGURE 1-11

COMMERCIAL-24 HOUR RANGE (Category C-24)

OPTIONAL EMERGENCY LIGHT, ADD ACFC IF 1000W FLASHED; OPTIONAL RL14-150/250W LAMP, FLAC 300, 120VAC

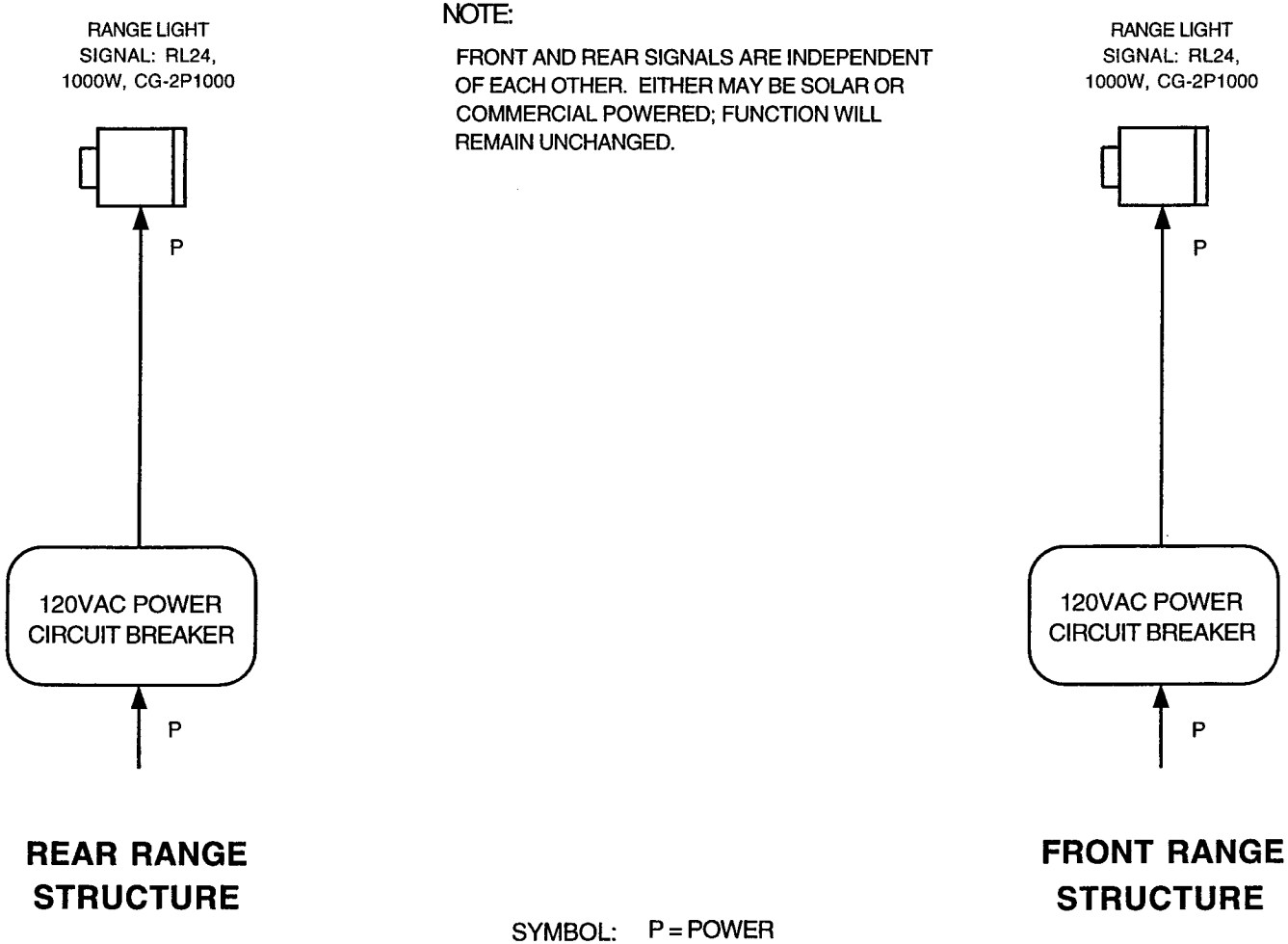


FIGURE 1-12

COMMERCIAL-DAY/NIGHT RANGE (Category C-D/N)

OPTIONAL EMERGENCY LIGHT. ADD ACFC IF 1000W FLASHED. OPTIONAL MULTIPLE DAYTIME RANGE LANTERNS

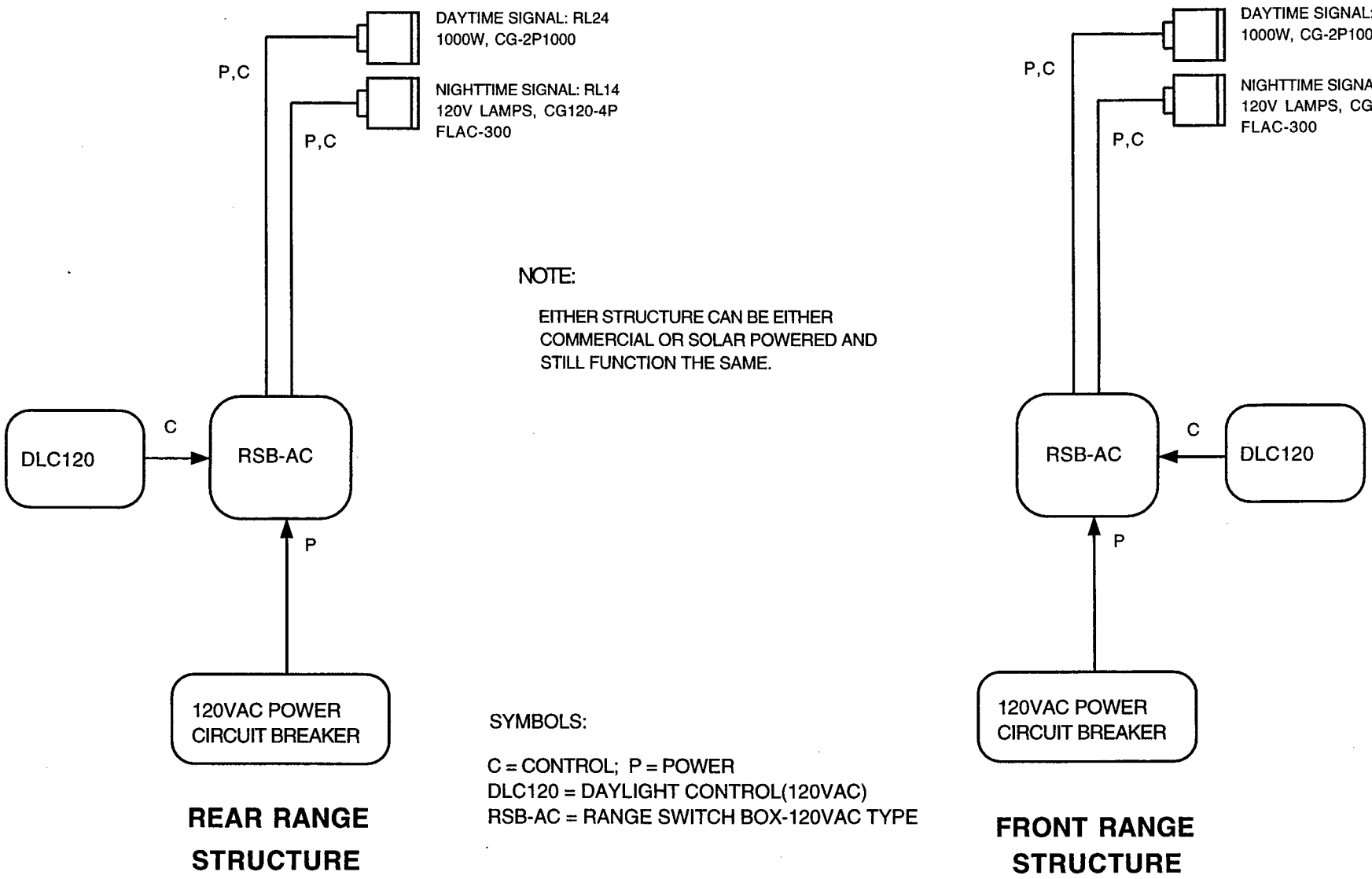
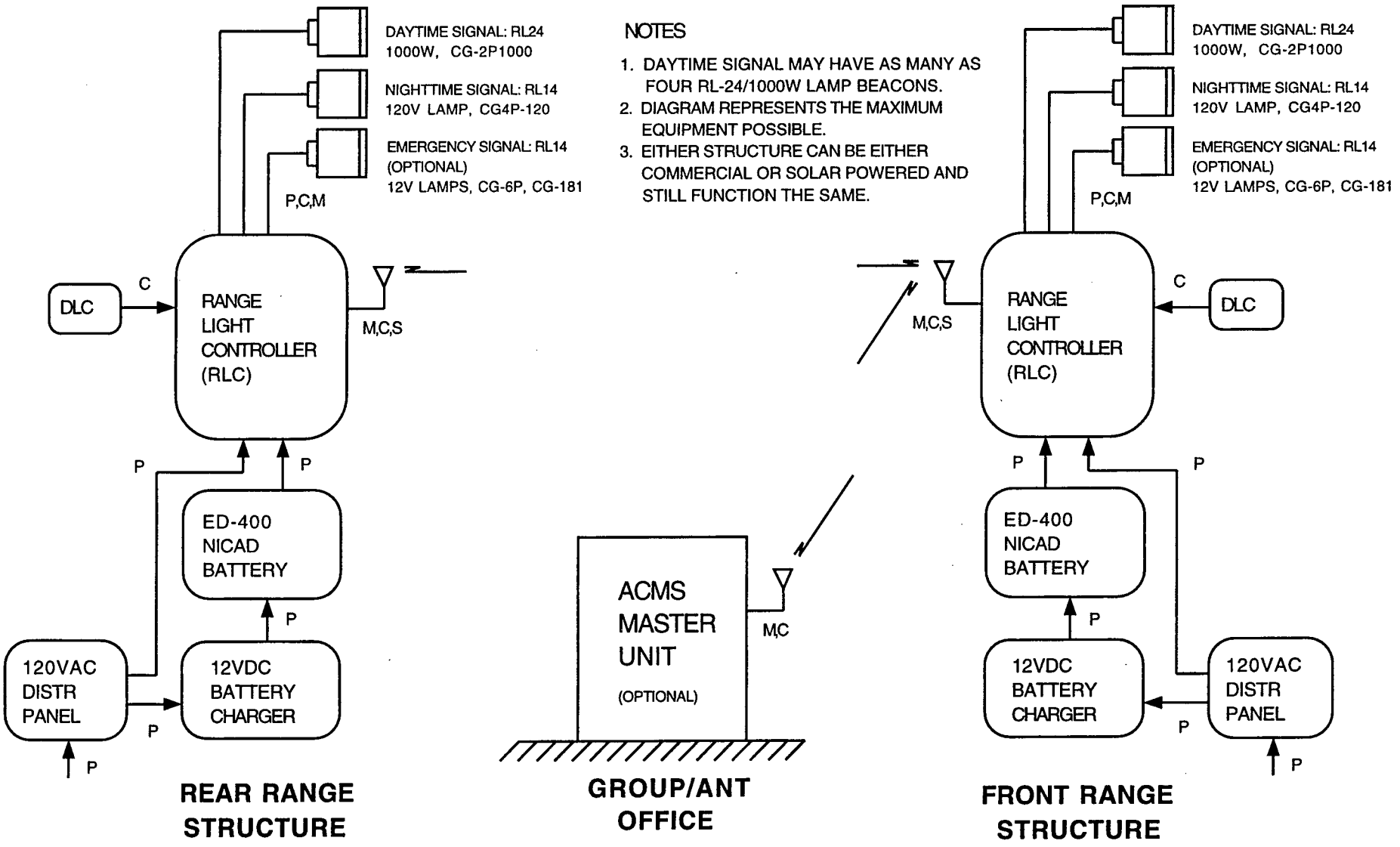


FIGURE 1-13

COMMERCIAL-DAY/NIGHT RANGE-SYNCH TRANSFER (Category C-RLC)

SWITCHING FROM DAY TO NIGHT SIGNALS (& VICE VERSA) SYNCHRONIZED BY RLCs TO OCCUR SIMULTANEOUSLY
120VAC POWERED, WITH EMERGENCY SIGNALS AND OPTIONAL ACMS MONITOR AT EXISTING MASTER UNIT



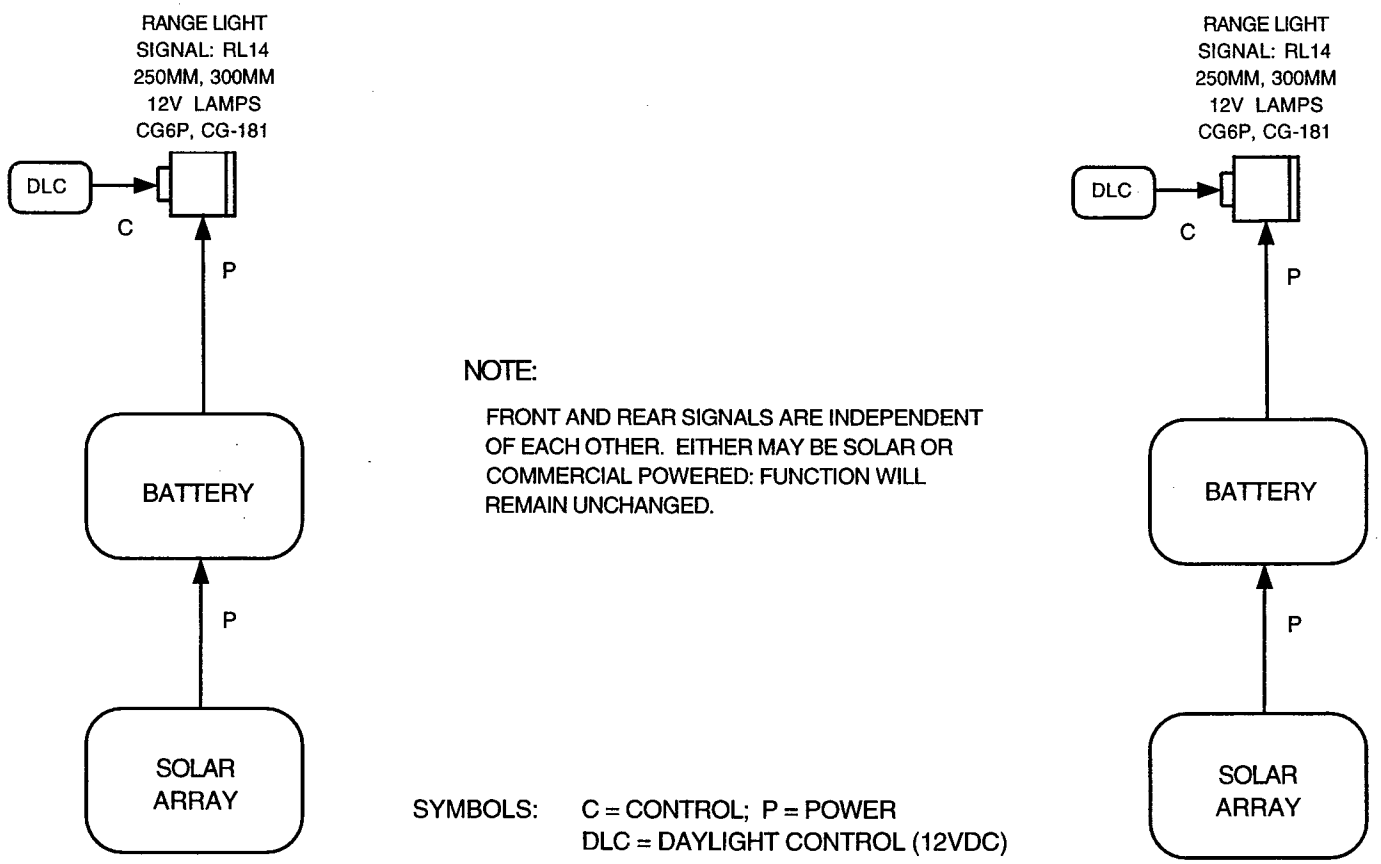
NOTES

1. DAYTIME SIGNAL MAY HAVE AS MANY AS FOUR RL-24/1000W LAMP BEACONS.
2. DIAGRAM REPRESENTS THE MAXIMUM EQUIPMENT POSSIBLE.
3. EITHER STRUCTURE CAN BE EITHER COMMERCIAL OR SOLAR POWERED AND STILL FUNCTION THE SAME.

SYMBOLS: M = MONITOR; P = POWER
C = CONTROL
S = SYNCHRONIZE F&R SIGNALS
DLC = DAYLIGHT CONTROL(12VDC)

FIGURE 1-14

SOLAR-NIGHT (ONLY) RANGE (Category S-N)

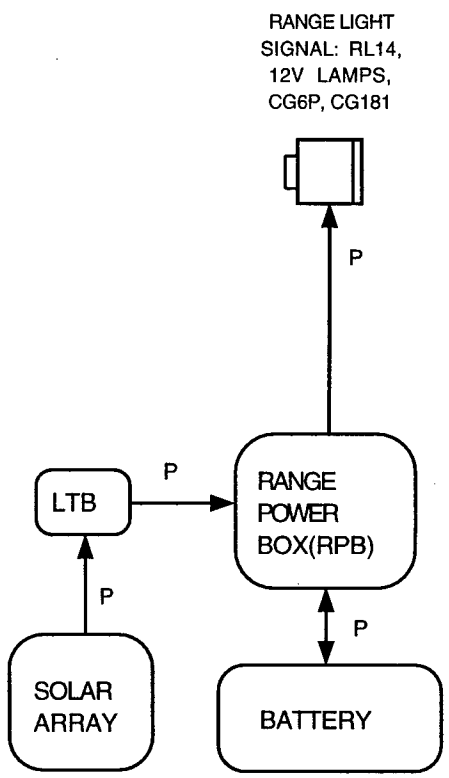


REAR RANGE STRUCTURE

FRONT RANGE STRUCTURE

FIGURE 1-15

SOLAR-24 HOUR RANGE (Category S-24)



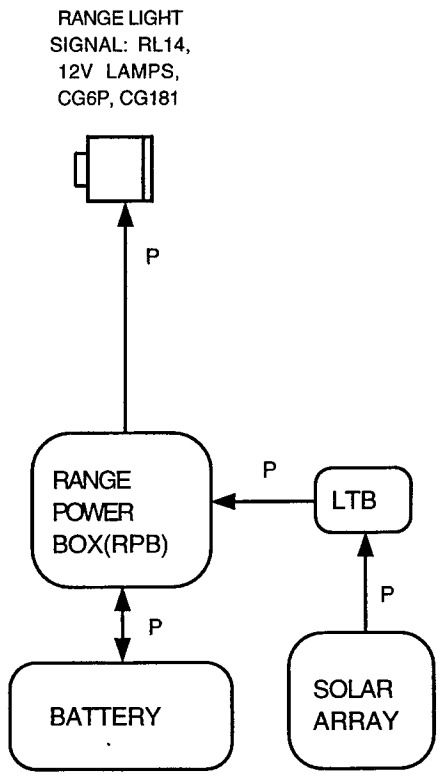
REAR RANGE STRUCTURE

NOTE:

FRONT AND REAR SIGNALS ARE INDEPENDENT OF EACH OTHER. EITHER MAY BE SOLAR OR COMMERCIAL POWERED: FUNCTION WILL REMAIN UNCHANGED.

SYMBOLS:

C = CONTROL; P = POWER
LTB = LOCAL TERMINAL BOX



FRONT RANGE STRUCTURE

FIGURE 1-16

SOLAR-DAY/NIGHT RANGE (Category S-D/N)

LOW VOLTAGE DISCONNECT, OPTIONAL MULTIPLE DAYTIME RANGE LANTERNS

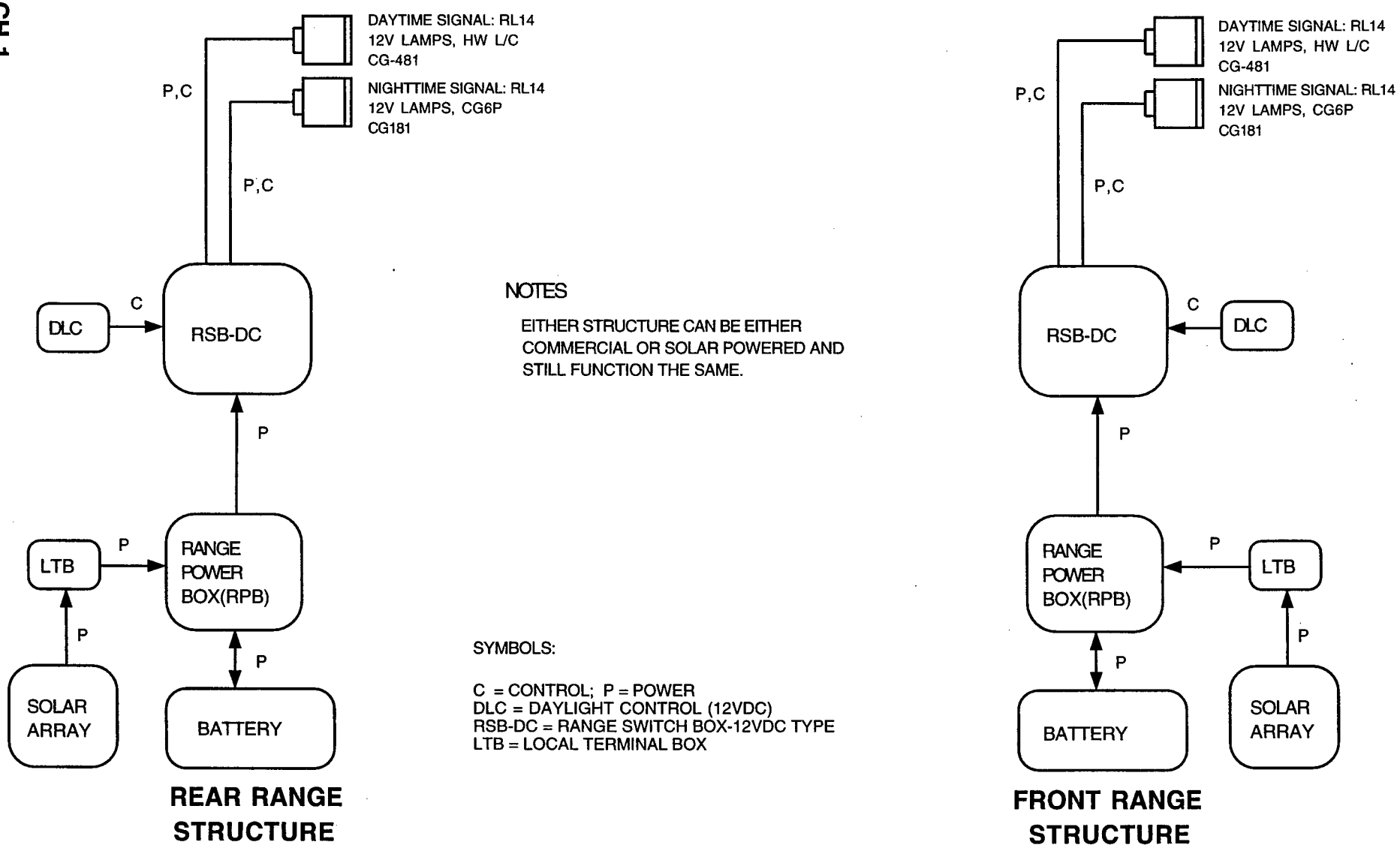


FIGURE 1-17

SOLAR-DAY/NIGHT RANGE-SYNCH TRANSFER (Category S-RLC)

SWITCHING FROM DAY TO NIGHT SIGNALS (& VICE VERSA) SYNCHRONIZED BY RLCs TO OCCUR SIMULTANEOUSLY
LOW VOLTAGE LOAD DISCONNECT, OPTIONAL AUXILIARY BATTERY, OPTIONAL ACMS MONITOR AT EXISTING MASTER UNIT

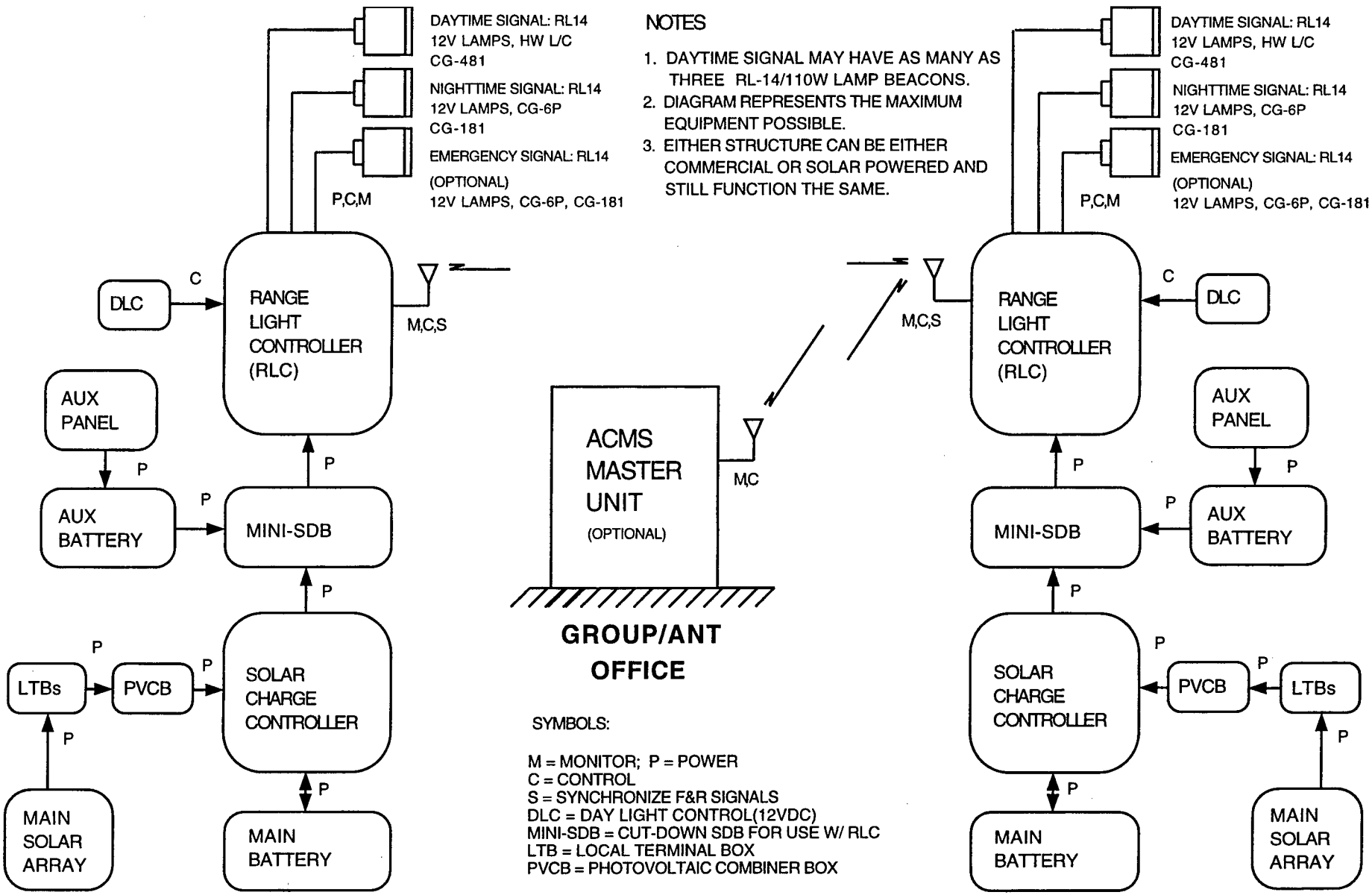


FIGURE 1-18

OPTIONAL EMERGENCY RANGE

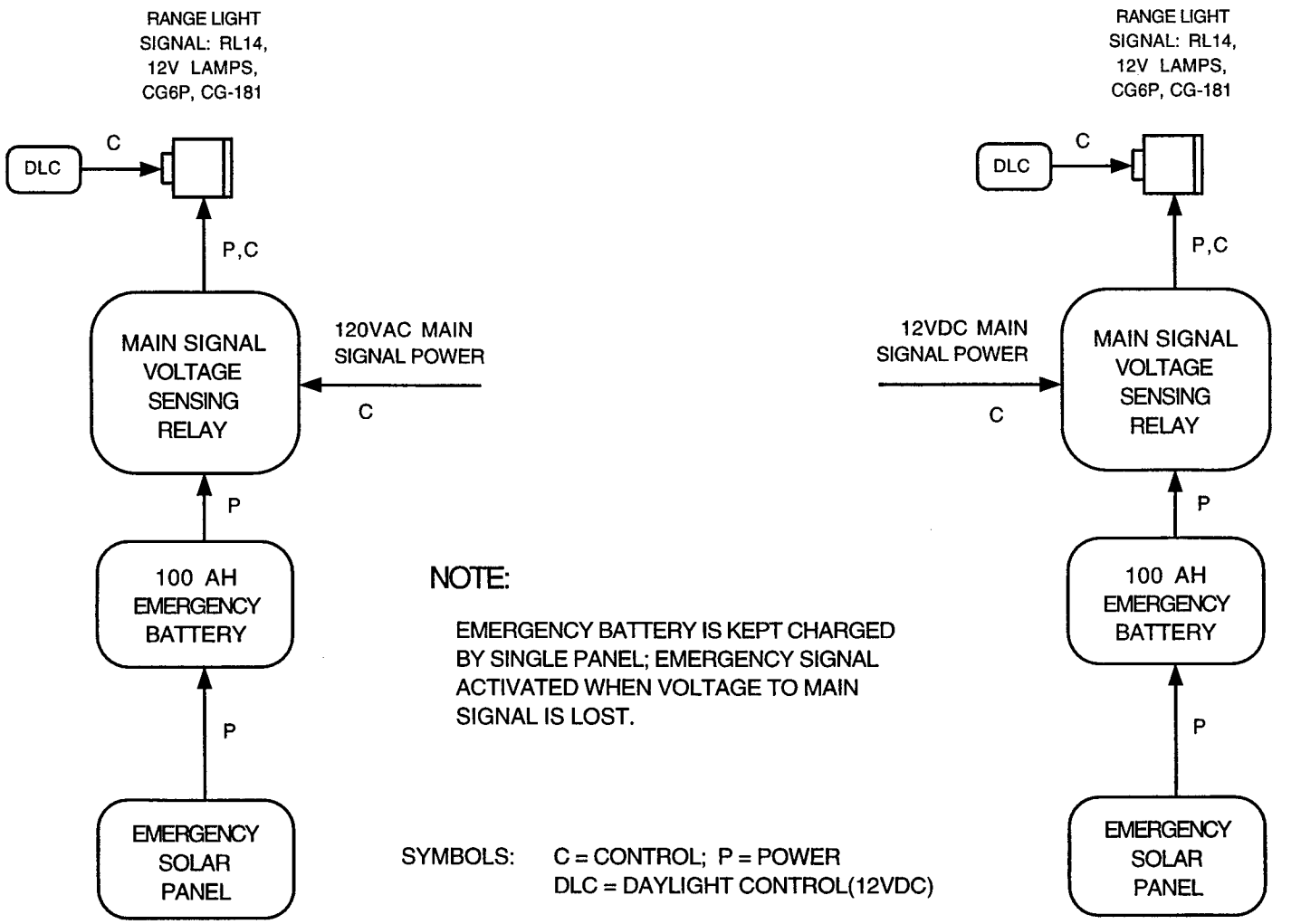


FIGURE 1-19

PROJECT DOCUMENTATION APPROVAL PROCESS

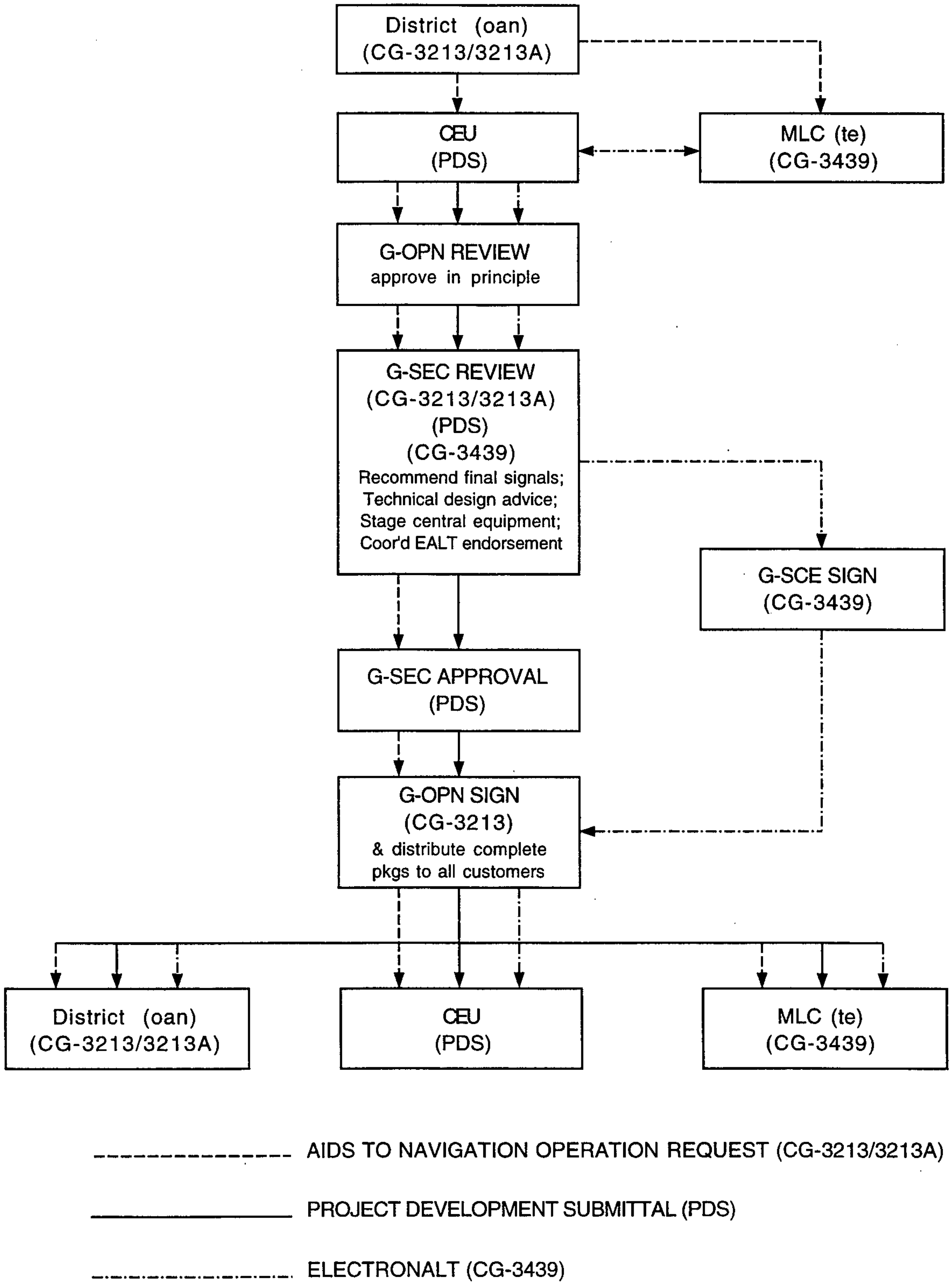


FIGURE 1-20